

### What Is Claimed Is:

1. An electromagnetic ultrasonic transducer for coupling-media-free generation and/or reception of ultrasonic waves in the form of linearly polarized transverse waves in a, respectively from a workpiece, having at least one unit which converts the ultrasonic waves inside the workpiece and which is provided with a coil arrangement for generating, respectively detecting a high-frequency magnetic field as well as with a premagnetizing unit for generating a quasi-static magnetic field which superimposes the high-frequency magnetic field in the workpiece, with the coil arrangement being disposed in a torus-shaped manner on at least one partially toroidal or U-shaped magnetic core, which each has two front ends which can be turned to face the workpiece,

**wherein** the front ends of the magnetic core which can be turned to face the workpiece are connected directly or indirectly to a magnetic flux piece which has a surface which faces the workpiece and which connects the front ends with each other.

2. The electromagnetic ultrasonic transducer according to the introductory part of claim 1,

**wherein** at least two magnetic cores and at least two magnetic flux guide pieces are provided,

one front end of a magnetic core is connected directly or indirectly to one of the at least two magnetic flux guide pieces and the other front end of a magnetic core is connected directly or indirectly to the other of the at least two magnetic flux guide pieces,

one front end of the other magnetic core is connected directly or indirectly to one of the at least two magnetic flux guide pieces and the other front end of the other magnetic core is connected directly or indirectly to the other of the at least two magnetic flux guide pieces each located at a distance from the first magnetic core, and

the magnetic flux guide pieces each have a surface facing the workpiece.

3. The electromagnetic ultrasonic transducer according to claim 2,  
**wherein** the at least two magnetic cores are each designed U-shaped and each have two longitudinal limbs connected via a connection part, the front ends being provided at the ends of the two longitudinal limbs,  
between the longitudinal limbs at least one further longitudinal element is provided which is connected on one side to the connection part at the end of which a further front end is provided, and  
at least one further magnetic flux guide piece connects the front ends of the longitudinal elements of both magnetic cores with each other.
4. The electromagnetic ultrasonic transducer according to claim 1 or 2,  
**wherein** to generate ultrasonic waves the coil arrangement is connected to a high-frequency generator to generate high-frequency magnetic fields.
5. The electromagnetic ultrasonic transducer according to claim 1 or 2,  
**wherein** to detect ultrasonic waves the coil arrangement is connected to an amplifier unit and/or to an evaluation unit.
6. The electromagnetic ultrasonic transducer according to claim 1 or 2,  
**wherein** the coil arrangement provides two separate coils, a transmission coil arrangement to generate a high-frequency magnetic field which is connected to a high-frequency generator and a reception coil arrangement for detecting a high-frequency magnetic field which is connected to an amplifier unit and/or to an evaluation unit.
7. The electromagnetic ultrasonic transducer according to one of the claims 1 to 6,  
**wherein** the magnetic flux guide piece is designed rod-shaped and contains soft magnetic material.
8. The electromagnetic ultrasonic transducer according to one of the claims 1 to 7,  
**wherein** the magnetic flux guide piece comprises a stack-shaped arrangement of soft magnetic board elements or is made of an electrically nonconductive material containing soft magnetic particles distributed in the form of a matrix.

9. The electromagnetic ultrasonic transducer according to one of the claims 1 to 8, **wherein** the front ends of the magnetic core are firmly fused with the magnetic flux guide piece.
10. The electromagnetic ultrasonic transducer according to one of the claims 1 to 9, **wherein** the premagnetizing unit is provided directly or indirectly on an upper side of the at least one magnetic flux guide piece facing away from the workpiece.
11. The electromagnetic ultrasonic transducer according to one of the claims 1 to 10, **wherein** the premagnetizing unit is a permanent magnet or an electromagnetic arrangement.
12. The electromagnetic ultrasonic transducer according to one of the claims 1 to 11, **wherein** the premagnetizing unit is disposed in such a manner that the quasi-static magnetic field can be introduced into the workpiece perpendicular to the surface of the workpiece.
13. The electromagnetic ultrasonic transducer according to one of the claims 1 to 10, **wherein** the premagnetizing unit is an electromagnetic arrangement by means of which a quasi-static magnetic field can be introduced into the workpiece horizontally to the surface of the workpiece.
14. An arrangement for coupling-media-free generating and/or for receiving ultrasonic waves in the form of linearly polarized transverse waves in a, respectively from a workpiece, **wherein** at least two electromagnetic ultrasonic transducers according to one of the claims 1 to 3 are disposed in parallel at a distance to each other in such a manner that the longitudinal directions of the respective magnetic flux guide pieces of the individual ultrasonic transducers are aligned in parallel.

15. The arrangement according to claim 14,  
**wherein** the premagnetizing units of the individual ultrasonic transducers are of the same name,  
or a single premagnetizing unit extends over all the magnetic flux guide pieces of the side-by-side-disposed ultrasonic transducers.
16. Use of the arrangement according to one of the claims 14 or 15 for generating and/or detecting horizontally polarized transverse waves,  
**wherein** the coil arrangements of the at least two electromagnetic ultrasonic transducers are operated by means of a phased-array triggering.
17. Use according to claim 16,  
**wherein** the coil arrangements of all the electromagnetic ultrasonic transducers are triggered consecutively with a time-delayed phase trigger signal in such a manner that when ultrasonic waves are generated the ultrasonic waves entering the workpiece possess a directional characteristic which is dependent on the phase triggering and whose main direction of propagation can be swung between  $0^\circ$  and  $90^\circ$  in relation to the normals to the workpiece.
18. Use according to claim 16 or 17,  
**wherein** in the course of generating ultrasonic waves inside the workpiece, the coil arrangements of the individual ultrasonic transducers are triggered in such a manner that two directly adjacent magnetic flux guide pieces which are oriented in opposite direction are each passed through by a magnetic flux.